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HISTORY OF THE TX-61 BOMB (U)

Weapon Systems

Personnel Division II 3232

Redacted Version

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CRITICAL NUCLEAR WEAPON DESIGN INFORMATION
---DOD DIRECTIVE 5210.2 APPLIES

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OPERATED FOR THE UNITED STATES ATOMIC ENERGY COMMISSION BY SANDIA CORPORATION | ALBUQUERQUE, NEW MEXICO, LIVERMORE, CALIFORNIA

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HISTORY OF THE TX-61 BOMB (U)

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Timetable of TX-61 Events

(b)(3)

Mid-1962	FUFO bomb program authorized to include the full range of Air Force and Navy fighters, Navy antisubmarine warfare aircraft, and multiple carriage in bombers of the Strategic Air Command.
1/18/63	FUFO bomb named TX-61.
8/20/63	First TX-61 free-fall ballistic test held at Tonopah Test Range.

(b)(3)

5/6/65	TX-61 nuclear system dimensions increased.
12/21/66	First War Reserve B61-0 accepted by the AEC.
May 1967	Production of B61-0 stopped.
Mid-1967	Modifications made on B61-0.
1/12/68	FPU of improved system accomplished.

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HISTORY OF THE TX-61 BOMB

(b)(1), (b)(3)

This weapon would be carried by Air Force Century series and STOL (Short Take-Off and Landing) aircraft.

(b)(3)

Compatibility with B-47 and B-52 aircraft appeared possible, and the group would consider application to the B-70.[3]

(b)(1), (b)(3)

Six weapons per bomb bay would be considered for the B-52, 4 weapons carried externally on pylons on the B-58, and 6 weapons per bomb bay in the B-70.

(b)(1), (b)(3)

One basic weapon configuration was desired, with maximum capability for both Tactical Air Command and Strategic Air Command applications.[5]

(b)(3)

(b)(3) A field conversion kit to mitigate the high heat environment would be required.

Another report covering the full-fuzing option was issued August 22, 1961, and it was noted that both the Air Force and Navy were interested in a lightweight bomb, although the requirements of the two Services differed considerably. It was anticipated that both sets of specifications could be satisfied by a single design if development was authorized.

By mid-1962 Sandia began to feel that a very lightweight full-fuzing option bomb was possible, and that the program would require a relatively short time scale, with completion in late 1965 or early 1966. Bomb carriers would include the full range of Air Force and Navy fighters, Navy antisubmarine warfare aircraft, and probably bombers of the Strategic Air Command.

(b)(1), (b)(3)

The Director of Defense Research and Engineering informed the Atomic Energy Commission (December 28, 1962) that the Joint Chiefs of Staff had recommended early development of a lightweight tactical nuclear weapon for carriage by present and future tactical aircraft. It was felt that such a weapon would improve aircraft capability, modernize the weapon stockpile, and simplify the tactical weapon inventory through replacement of lower-yield versions of the Mk 28 and Mk 43 weapons.

(b)(1), (b)(3)

Carriage on Naval aircraft, as well as follow-on strike aircraft, would be similar to that for the Mks 28 and 53. The desired first production date was June 1965 and the Air Force would be the cognizant agency for the Department of Defense portion of the development work, with normal participation by the Defense Atomic Support Agency.[8]

(b)(1), (b)(3)

Environmental criteria for the TX-61 were specified. Temperature extremes from -65 to ±160 degrees F might be experienced for indefinite periods of time. Shock environments would include 50 g vertical, 40 g transverse, or 30 g longitudinal while the bomb was being transported or stored aboard ship. The exterior surfaces of the bomb might experience a maximum temperature of +275 degrees F for about 40 minutes, but all temperature-critical components would be insulated. Parachute deployment would subject the bomb to a maximum load of 255 g along the longitudinal axis.[12]

(b)(1), (b)(3)

By March 1963 the weapon was being designed so that it could be released without aircraft power after arming.

(b)(1), (b)(3)

It was hoped that the weapon would be more rugged than the Mk 57. An integrated nose assembly would contain a radar, impact crystals, and shock mitigation.

(b)(1), (b)(3)

The heavy case enclosing the nuclear assembly fuzing and firing components was being designed for maximum strength and minimum weight.

(b)(1), (b)(3)

Components would be potted and packed in foam to provide shock resistance. The afterbody would be a sheet metal assembly and would contain a power-deployed parachute system similar to that of the TX-57.[14]

The TX-61 ballistic contour would consist of a Von Karman nose, a cylindrical center section, and a parabolic afterbody. Four fins would provide stability during the drop trajectory for the free-fall

options. The unit would be parachute-retarded for the laydown and retarded-airburst options. Sufficient retardation would be provided to permit delivery from 50 feet above target elevation.[15]

The bomb would be timer-armed in all options. The firing signal would be provided by radar in the airburst option, by piezoelectric crystals in the freefall ground-contact option, and by timer in the laydown option. A gap-fired transverter-capacitor firing set and electronic neutron generators had been designated for the warhead electrical system.

(b)(1), (b)(3)

The forward subassembly would contain a bomb radar nose and its associated power supply, impact fuzes, radome, and case section. Because of the requirement for a low-drag shape to permit the weapon to be carried at supersonic speeds, the nose assembly would be pointed, and would be tipped with metal to prevent damage from rain erosion.

The center bomb subassembly would contain any elements requiring protection during laydown deliveries. These included the nuclear system, boosting reservoir and valve, firing set, permissive action link, neutron generator, sequential timer system, ready/safe rotary switch, trajectory-arm inertial switch, interval timer, and thermal batteries.

All fuzing and firing components and some nuclear system components would be mounted in polyurethane foam to maximize packaging density and to protect against laydown shock. This foam also provided thermal insulation to hold component temperatures within operational limits during supersonic carriage.

(b)(1), (b)(3)

The velocity sensor for environment sensing during freefall differed from the ones in previous weapons in that it obtained ram air pressure through a port that was located not on the weapon skin but on a cylinder which, when projected into the air stream, lifted the port about 3/4 inch from the weapon surface to prevent skin interference with air flow.

Capability would be provided for selecting any fuzing option while the delivery aircraft was airborne, as well as a preflight capability for choosing retarded or freefall delivery. Two adjustable safe-separation times would be settable before flight, and selection between these times could be made in flight. Both high and low burst heights, as well as contact backup enable, or nonbackup for the airburst options, would be selectable before flight.

(b)(1), (b)(3)

There would be some constraints on F-111 external carriage of the Mk 57, but it was felt that these would not be too severe.

The first TX-11 freefall ballistic test was held at the Tonopah Test Range August 20, 1963.

(b)(1), (b)(3)

Separation from the aircraft was clean and the weapon was stable throughout its trajectory.[16]

(b)(1), (b)(3)

Until the F-111 aircraft became available, it would be difficult to simulate this environment exactly, but some preliminary tests would be made at the rocket-sled facility in Area 3. A portable radiant-heat chamber would be used to heat the bomb, which would then be mounted on a rocket sled. When the sled had been accelerated to the proper velocity, the weapon would be ejected upward. After a prescribed delay after ejection, a gas generator would be fired, the parachute deployed, and the unit would describe a normal trajectory and impact on a flat concrete target.[17]

(b)(1), (b)(3)

Although additional development time, tradeoffs, and

probably nuclear tests would be required to attain this end, the change would be worthwhile.

(b)(1), (b)(3)

Carriage of the bomb by RF-4C aircraft was specified.[18]

(b)(1), (b)(3)

This would entail some redesign, but it was felt possible to produce a satisfactory laydown weapon. Diameter and length of the weapon would not be changed, but the weight would be increased by about 10 pounds.[19]

At this time, compatibility of the TX-61 in the freefall option with internal carriage in the F-105 had not been demonstrated, and it was thought that the aircraft suspension system might have to undergo a major redesign. The military characteristics had been amended to eliminate contact backup in the freefall option, and a strike-enable plug was added to the fuze at Navy request.

(b)(1), (b)(3)

It had been decided that trajectory arming in the freefall option would be accomplished by angular acceleration produced by a spin rocket motor. This motor, ignited shortly after bomb release, would impart a spin of 5 revolutions per second to the weapon to prevent coupling and instability under high-Mach, high-altitude release conditions.

(b)(1), (b)(3)

(b)(1), (b)(3)

Sandia notified the Division of Military Application that this amendment could be attained with relatively minor changes to the weapon.[26, 27]

By late 1964 discussions were being held within Sandia concerning an apparent inconsistency in the TX-61 fuzing system.

(b)(1), (b)(3)

It was pointed out that the minimum safe-separation time presently achievable in the weapon when delivered in the freefall mode was 12 instead of the advertised 10 seconds. This inconsistency was a result of a 3-second delay provided in the freefall-trajectory arming circuit. This delay dircuit prevented operation of the trajectory arming unit until 3 seconds after weapon release. When a safe separation time of 10 seconds was desired, the device was programmed to start 1 second after weapon release. However, the system could allow an additional 2 second delay, and this would result in an overall safe separation time of 12 seconds.

A spin-rocket safety-hazard tower test was conducted January 21, 1964, and showed that the 3-second delay was required. Two approaches appeared feasible; to redesign the electrical system so that a minimum safe separation time of 10 seconds could be attained when using the freefall delivery mode, or to determine whether a minimum safe separation time of 12 seconds would be compatible with the freefall delivery maneuvers specified in the stockpile-to-target sequence.

(b)(1), (b)(3)

For a minimum flight time of 16 seconds, a minimum safe separation time of 15 seconds would have to be provided so as to allow 1 second for final bomb arming. Thus the 12-second minimum safe separation time currently provided in the freefall version was adequate for the approach and delivery conditions defined in the stockpile-to-target sequence, and no modification of the timing system or junction box was required to provide compatibility with the 3-second trajectory arming delay and the minimum safe separation time of 10 seconds.[28]

The Division of Military Application notified the Albuquerque Operations Office December 24, 1964, that the first production unit date for the TX-61, in view of recent changes, would be deferred to January 1967.[29]

(b)(1), (b)(3)

A review of the development test program in late 1964 showed

that about half of the ballistic freefall and laydown tests (both sled and aircraft drops) had been completed. All these had been successful, except for a failure to stop the parachute deployment tube. Only two laydown fuzing and firing tests had been completed. The first failed due to jitter in the ready-safe switch, and the second drop missed the concrete target.

(b)(1), (b)(3)

Consideration was being given to using rocket shots or delayed parachute deployment after freefall from high altitude.[30]

Sandia notified the Division of Military Application on May 6, 1965 that some essential changes to the TX-61 nuclear system would increase the diameter of the bomb from 12.75 to 13.30 inches and the weight from 600 to700 pounds. It was felt that the established first production date could still be met.[31]

The first War Reserve TX-61-0 was accepted by the AEC October 21, 1966, which was in conformance with the scheduled production date.

(b)(1), (b)(3)

Sandia Corporation and Bendix improved manufacturing and testing procedures for the Programmer and the Air Force revised the parachute packing inspection procedures and strengthened the bag loops.

FPU of the improved system was accomplished January 12, 1968.

(b)(1), (b)(3)

The diameter is 13.3 inches, the length 141.6 inches, and the weight is about 715 pounds.

The bomb is timer-armed in all options. Firing signals are provided by radar for airburst options, by piezoelectric crystals for contact (freefall ground burst) option, and by timer for the laydown option.

(b)(3)

DOE b(3)

In all options, an escapement-regulated interval timer is used with radially or longitudinally acting acceleration switches to provide trajectory arm-

ing. A gap-fired transverter-capacitor firing set and an electronic neutron generator are provided to initiate weapon detonation.

(b)(1), (b)(3)

Glossary of TX-61 Terms

Albuquerque Operations Office -- The local office of the Atomic Energy Commission (AEC) concerned with the operations of Sandia Corporation.

(b)(1), (b)(3)

Design Review and Acceptance Group -- A military committee established to review the design of a specific weapon.

Director of Defense Research and Engineering -- The former Assistant Secretary of Defense. Handles research and development activities for the Department of Defense.

Division of Military Application -- An AEC office that functions as liaison between the Military and weapons designers and producers.

Environment-Sensing Device -- A device that reacts to a specific environment of the weapon, such as speed, acceleration, altitude, etc.

Field Command -- The local office of the Armed Forces Special Weapons Project (Defense Atomic Support Agency), located on Sandia Base, Albuquerque, New Mexico.

Freefall Bomb -- A bomb that falls under the forces of gravity and the impetus given at time of release.

Kilogram -- A metric weight approximating 2.2 pounds.

Kiloton -- A means of measuring the yield of an atomic device by comparing its output with the effect of an explosion of TNT. A 1-kiloton yield is equivalent to the detonation effect of 1000 tons of high explosive.

Lawrence Radiation Laboratory -- A nuclear design organization located at Livermore, California.

Laydown Device -- A bomb capable of being dropped on a relatively hard target or surface and surviving in a condition to later detonate.

Los Alamos Scientific Laboratory -- A nuclear design organization located at Los Alamos, New Mexico.

Mach -- A measure of speed. Mach 1.0 is the speed of sound, or 738 miles per hour at sea level.

Megaton -- A measure of yield of a large weapon. One megaton is the equivalent of 1,000,000 tons of high explosive.

Military Liaison Committee -- A Department of Defense committee established by the Atomic Energy Act to advise and consult with the AEC on all matters relating to military applications of atomic energy.

(b)(1), (b)(3)

Permissive Action Link -- A device designed to delay or prevent unauthorized personnel from being able to arm and detonate a weapon full scale.

Primary -- A fission bomb that acts as the source of energy to start the secondary or thermonuclear reaction of a two-stage device.

(b)(1), (b)(3)

(b)(1), (b)(3)

Uranium-235 -- A radioactive element, an isotope of uranium-238.

War Reserve -- National stockpile of nuclear weapons.

Yield -- The measure of the effect of a nuclear detonation compared to the effect of an explosion of TNT.

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References

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2.

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3.

4.

5. SRD TWX, RS3466/149549, Field Command to Sandia Corporation, dtd. 6/2/61. SC Central Technical Files, Folder TX-61 FUFO-11.

6. LXI-6238, AEC Weapons Development Status Report, dtd. 11/1/61. SC Reports File.

7.

(b)(3)

8. SRD Ltr, RS8232/62020, Director of Defense, Research and Engineering to the Chairman, AEC, dtd. 12/28/62. SC Central Technical Files, Folder Feasibility Studies, Livermore.

9.

(b)(3)

10. SRD Ltr, RS3446/59511, Division of Military Application to Albuquerque Operations Office, dtd. 2/11/63, subject, Phase III Authorization for Tactical Bomb. SC Central Technical Files, Folder TX-61, 1-1.

11.

(b)(3)

12. SRD Ltr, RS7100/1551, Director 7100 to Director 1400, dtd. 3/12/63, subject, Environmental Design Criteria for the TX-61. SC Central Technical Files, Folder 61, Program January through April 1963, 1-6.

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24.

25. (b)(1), (b)(3)

26.

27. SRD Ltr, RS1000/3873, Vice-President 1000 to Division of Military Application, dtd. 8/19/64, subject, Comments on Amendment 4 to the Military Characteristics, TX-61. SC Central Technical Files, Folder 61, Program 1-6.

28. SRD Ltr, RS1534/125, Division 1534 to Division 1513, dtd. 11/27/64, subject, Minimum Freefall Safe Separation Times. SC Central Technical Files, Folder 61, Program 2-2.

29. SRD TWX, RS3427/56267, Division of Military Application to Albuquerque Operations Office, dtd. 12/24/64. SC Central Technical Files Folder TX-61, 1-6.

30. SRD Minutes, RS3427/55151, TX-61 Informal Advisory Group, Third Meeting, dtd. 1/12/65. SC Central Technical Files, Folder 61, Program 1-7.

31. CRD Ltr, President, Sandia Corporation to Division of Military Application, dtd. 5/6/65, subject, Changes to the TX-61 Program. SC Central Technical Files, Folder TX-61, Livermore.

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(b)(3)

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(b)(1), (b)(3)

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TX-61 delivery sequences

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